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REPORT OF THE JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR WATER METERS

The Joint Committee of the American and New England Water Works Associations, on Standard Specifications for Water Meters, submits its final report, accompanied by a draft of Standard Specifications for Cold Water Meters, Disc Type, which it recommends for adoption; a statement of the information which should be furnished to meter manufacturers when requesting bids under the proposed specifications; a description of the equipment necessary to test meters for compliance with the registration and capacity requirements of the specifications; and a statement of tests recommended.

Appointment, organization and meetings of committee. The formation of a committee on meter specifications was suggested by R. J. Thomas, who presented a brief paper to the convention of the New England Water Works Association at Portland, Maine, in 1916, calling attention to the desirability of uniform standard specifications for meters. Following the presentation of that paper it was voted that a committee of the New England Water Works Association be appointed.

In 1919, upon the representation of members of the New England Association's committee to the American Association, the latter voted to appoint a similar committee, which was done forthwith.

The first actual meeting of the Joint Committee, or of either of the committees appointed by the Associations, was held on March 9 and 10, 1920. Prior to that time such progress as had been made was accomplished by correspondence.

It was immediately decided to organize as a Joint Committee, and to make a single report to both Associations. The committee organized with Charles W. Sherman as Chairman and Seth M. Van Loan as Secretary.

At the conclusion of the meeting of March 9 and 10, 1920, a sub-committee consisting of Messrs. Saville, Brush, Van Loan and McMurry, was appointed, to give further consideration to points raised in the main committee, to carry out certain experimental work, and to obtain some further information from the manufacturers, and to report back to the Joint Committee at a later date.

The second and concluding meeting of the Joint Committee was held February 8 and 9, 1921, at which time the draft of the specifications was tentatively adopted and the form of the report considered. The final work of the committee has been accomplished by correspondence.

Preliminary work of New England Water Works Association Committee. Correspondence between the members of the New England Association's committee began soon after the original appointment in 1916, but before anything of significance had been accomplished the United States entered the World War and it became impracticable for the members of the committee to devote any material amount of time to committee work. Late in 1917, however, the Department of Water Supply, Gas and Electricity of New York City prepared a tentative draft of specifications, under the direction of W. W. Brush, a member of the committee. After further correspondence between the members of the Committee it was planned to print these tentative specifications as a basis for discussion, and submit them to the 1918 convention of the New England Water Works Association, as a progress report, but before this was done information from the manufacturers indicated that certain points in the tentative draft should be discussed with the manufacturers before submitting them to any convention, and the draft was therefore not circulated.

Draft of specifications prepared by meter manufacturers. During 1918 and 1919 the manufacturers on water meters held a series of conferences under the auspices of the Meter Manufacturers' Exchange but to which manufacturers not members of that Exchange were invited, at which they discussed the subject of specifications and finally prepared a draft of standard specifications acceptable to all of them. These conferences were held in New York City and during the latter part of the time were attended by W. W. Brush, as representative of the New England Association's committee. They concluded in February, 1920, when a draft of standard specifications acceptable to the manufacturers was completed.

The Meter Manufacturers' Exchange includes the Buffalo Meter Co., Hersey Manufacturing Co., Neptune Meter Co., Pittsburgh Meter Co., Thomson Meter Co., Union Water Meter Co., and Worthington Pump and Machinery Co. Other manufacturers not members of the Exchange are Badger Meter Co., Gamon Meter Co., and National Meter Co. It is the understanding of the Committee that all of the manufacturers were either represented at the

conferences or subsequently assented to the action taken at those meetings.

The specifications thus drafted and submitted to the Joint Committee of the Water Works Associations covered both the disc and current types of meter.

Work of the joint committee. Following receipt from the manufacturers of their draft of a standard specification, the Joint Committee met on March 9 and 10, 1920, as above noted, and proceeded to analyze and discuss the specifications submitted by the manufacturers.

It was at once decided to limit the Committee's work to specifications for disc meters, for several reasons, the most potent being that substantially all of the meters likely to be bought under competitive bidding belong to this class. It was also felt that if standard specifications for disc meters were adopted, after they had been in use a number of years the experience with them would indicate more clearly than can now be anticipated, the kind of specifications which should be prepared to cover other classes of meters.

During the year 1920 the sub-committee continued the investigation of various questions left unsettled by the Joint Committee, and finally reported back to the committee a revised draft of specifications, a statement of information which should be furnished to bidders in asking for bids under the specifications, a description of the tests necessary to determine whether meters complied with the specifications, and a list of the minimum equipment with which such tests could be made.

At the final meeting of the Committee on February 8 and 9, 1921, the material submitted by the sub-committee was discussed in detail and amended in some minor particulars, and then referred back to the sub-committee for submission to the manufacturers. Further slight modifications have been made as a result of comments by manufacturers, and the material as thus finally revised has been accepted by the Committee, through correspondence.

Acknowledgment. In presenting the proposed specifications to the two associations for their consideration, the Joint Committee wishes particularly to acknowledge its indebtedness to the meter manufacturers, who showed throughout an earnest desire to coöperate and to comply with all reasonable requirements, and particularly to standardize details of construction with the object of making

meters of various makes interchangeable in service, without re-arrangement of connections.

April 7, 1921.

Respectfully submitted,

For the Joint Committee,

CHARLES W. SHERMAN, Chairman

N. E. W. W. Assoc. Committee

Am. W. W. Assoc. Committee

W. W. BRUSH, Chairman

C. M. SAVILLE, Chairman,

CHARLES W. SHERMAN

DOW R. GWINN

A. W. F. BROWN

R. J. THOMAS

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SETH M. VAN LOAN

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Standard specifications for cold water meters, disc type

Cases. All meters shall have an outer case with a separate inner chamber in which the disc operates. The outer case for all 2-inch and smaller meters shall be of bronze composition. Cast-iron frost bottoms may be provided. The outer case for meters larger than 2 inches shall be of bronze composition or of cast iron protected by a non-corrosive treatment.

All meters shall have cast on them in raised characters the size and the model, and the direction of the flow through the meter shall be properly indicated. Meters larger than 1-inch shall be designed for easy removal of all interior parts, without disturbing the connections to the pipe line.

External bolts. All external bolts shall be made of bronze or of galvanized iron or steel. Nuts shall be designed for easy removal after having been long in service.

Registers. Registers may be either "round" or "straight" reading, indicating in cubic feet or gallons.

All parts of the registers shall be made of non-ferrous material. The maximum indication of the initial dial and the minimum capacity of the register when indicating cubic feet, shall be as follows:

<i>Size inches</i>	<i>Maximum indication of initial dial cu. ft.</i>	<i>Minimum capacity of register cu. ft.</i>
$\frac{5}{8}$	1	100,000
$\frac{3}{4}$	10	1,000,000
1	10	1,000,000
$1\frac{1}{2}$	10	1,000,000
2	10	10,000,000
3	10	10,000,000
4	100	100,000,000
6	100	100,000,000

All dials, including the initial dial, shall be sub-divided into ten equal parts. All hands or pointers shall taper to a sharp point. They shall be accurately set and securely held in place.

Register boxes. Register boxes and lids shall be made of bronze composition or same material as the top case, with the name of the manufacturer cast on the lid in raised letters. The serial number of the meter shall be plainly stamped on the lid. If required, the serial number shall also be stamped on the case. The lid shall be recessed and shall lap over the box to prevent dirt from accumulating on the glass. The glass shall be inserted from the inside and securely held in place without the use of putty or pins. All register compartments shall be provided with a water-escape hole $\frac{1}{8}$ inch in diameter, placed so that the change gear or registering mechanism cannot be tampered with.

Connections for $\frac{3}{8}$ -, $\frac{1}{2}$ -, and 1-inch sizes. Spuds shall be threaded $\frac{3}{8}$, 1, and $1\frac{1}{4}$ inches respectively, male thread standard pipe size, and so threaded that Briggs standard pipe thread ring gages may be screwed on by hand within one thread of through the gage.

Over-all lengths of meters, face to face of spuds, shall be:

Size	Length
$\frac{5}{8}$ inch	$7\frac{1}{2}$ inches
$\frac{3}{4}$ inch	9 inches
1 inch	$10\frac{3}{4}$ inches

Couplings shall be made of bronze composition. Nuts shall be tapped $\frac{3}{8}$, 1 and $1\frac{1}{4}$ inches respectively, straight thread, standard pipe size and so tapped that Briggs standard pipe thread plug gages may be backed into the nuts by hand, i.e., the size of the thread in the nut is the maximum size of the Briggs plug but no larger. Tail pieces shall be threaded $\frac{1}{2}$, $\frac{3}{4}$ and 1 inch respectively, male thread, standard pipe size, and so threaded that Briggs standard pipe thread ring gages may be screwed on by hand, flush with the face of the gage.

Over-all lengths of tail pieces shall be:

Size	Length
$\frac{5}{8}$ inch	$2\frac{3}{8}$ inches
$\frac{3}{4}$ inch	$2\frac{1}{2}$ inches
1 inch	$2\frac{5}{8}$ inches

Connections for $1\frac{1}{2}$ - and 2-inch sizes. Spuds shall be tapped $1\frac{1}{2}$ and 2 inches respectively, female thread, standard pipe size, and so tapped that Briggs standard pipe thread plug gages may be screwed on by hand up to the notch on the plug.

Over-all lengths of meters, face to face of spuds, shall be:

Size	Length
$1\frac{1}{2}$ inches	$12\frac{3}{4}$ inches
2 inches	$15\frac{1}{4}$ inches

Couplings shall be made of bronze composition. Nuts shall be tapped 2 and $2\frac{1}{2}$ inches respectively, straight thread, standard pipe size and so tapped that Briggs standard pipe thread plug gages may be backed into the nuts by hand, i.e., the size of the thread in the nut is the maximum size of the Briggs plug but no larger. Tail pieces shall be threaded $1\frac{1}{2}$ and 2 inches respectively, male thread, standard pipe size, and so threaded that Briggs standard

pipe thread ring gages may be screwed on by hand flush with the face of the gage. 2 by $1\frac{1}{2}$ -inch and $2\frac{1}{2}$ by 2-inch standard pipe size malleable iron bushings are to be furnished with $1\frac{1}{2}$ -inch and 2-inch couplings respectively. Care should be taken to see that nuts as above described can be screwed on to the bushings by hand and that the face of the bushings will be sufficiently true and square to provide a proper packing surface.

Over-all lengths of tail pieces shall be:

Size	Length
$1\frac{1}{2}$ inches	$2\frac{7}{8}$ inches
2 inches	3 inches

Connections for 3, 4 and 6-inch sizes. Spuds shall be flanged, faced and drilled. Companion flanges shall be of cast iron, faced, drilled and tapped. All dimensions, drilling and tapping shall conform exactly to American standard of January 1, 1914.

Over-all lengths of meters, face to face of flanges, shall be:

Size	Length
3 inches	24 inches
4 inches	29 inches
6 inches	$36\frac{1}{2}$ inches

Seal wire holes. $\frac{3}{8}$, $\frac{1}{2}$, 1, $1\frac{1}{2}$ and 2-inch meters shall have register box screws and coupling nuts drilled for seal wire holes. Meters larger than 2 inches in size shall have register box screws drilled for seal wire holes. All seal wire holes shall not be less than $\frac{3}{32}$ inch in diameter.

Measuring chambers. The measuring chamber for all meters shall be made of bronze composition and shall not be cast as part of the outer casing. It shall be machined with great care and secured in position in the outer casing so that any slight distortion of the casing which might take place under 150 pounds working pressure will not affect the sensitiveness of the meter.

Discs. Disc pistons shall be made of vulcanized rubber, and shall be fitted accurately but freely in their chambers. Vulcanized rubber pistons shall have a metal reinforcement or a thrust roller.

Intermediate gear trains. The intermediate gear trains shall be of such construction as to be easily removed and shall be made throughout of non-ferrous material. Gear spindles may run in bearings bushed with hard rubber provided the bushings are so constructed that they cannot drop out.

Strainers. All meters shall be provided with strainers except when self-strained by means of an annular space between the measuring chamber and the external case. Strainers shall be made of non-ferrous materials and shall fit tightly against the wall of the casing. They shall have an effective straining area as large as practicable and at least double that of the inlet.

Registration. The registration on the meter dial shall indicate the quantity recorded to be not less than 98 per cent nor more than 102 per cent of the water actually passed through the meter while it is being tested at rates of flow within the limits specified herein under "normal test flow limits." There shall be not less than 90 per cent of the actual flow recorded when a test is made at the rate of flow set forth under "minimum test flow."

<i>Size, inches</i>	<i>Normal test flow limits, gallons per minute</i>	<i>Minimum test flow, gallons per minute</i>
$\frac{5}{8}$	1 to 20	$\frac{1}{4}$
$\frac{3}{4}$	2 to 34	$\frac{1}{2}$
1	3 to 53	$\frac{3}{4}$
$1\frac{1}{2}$	5 to 100	$1\frac{1}{2}$
2	8 to 160	2
3	16 to 315	4
4	28 to 500	7
6	48 to 1000	12

Capacity. New meters shall show a loss of head not exceeding 25 pounds per square inch, when the rate of flow is that given in the following table:

<i>Size, inches</i>	<i>Gallons per minute</i>
$\frac{5}{8}$	20
$\frac{3}{4}$	34
1	53
$1\frac{1}{2}$	100
2	160
3	315
4	500
6	1000

Pressure test. Disc meters shall be guaranteed to operate under a working pressure of 150 pounds per square inch without leakage or damage to any part.

Workmanship and material. Disc meters shall be guaranteed against defects in materials and workmanship, for a period of one year from date of shipment. Parts to replace those in which a defect may develop within such period shall be supplied without charge, piece for piece, upon the return of such defective parts to the manufacturer thereof or upon proper proof of such defect.

Rejected meters. The manufacturer shall at his own expense, replace or satisfactorily readjust all meters rejected for failure to comply with these specifications.

Information to be furnished to meter manufacturers when requested to submit bids on disc meters

1. Meters shall conform to the standard specifications for cold water meters, disc type, adopted by the American and New England Water Works Associations.

2. The manufacturer shall state in his bid, the type of meter he proposes to furnish, as listed in his catalogue. The actual capacity of each size of meter called for is to be given graphically from 0 pounds up to 25 pounds loss of pressure. If this capacity be stated in the manufacturer's catalogue, reference may be made thereto.

3. No bid will be considered on meters of a design which has not been listed for at least one year in the catalogue regularly issued by the manufacturer.

4. The method of testing meters shall conform to that recommended by the Committee on standard specifications for water meters.

5. (a)* The meters are to be accepted on a certificate furnished by the manufacturers, that the meters have met the requirements of the standard specifications for water meters, as adopted by the American and New England Water Works Associations.

(b)* The meters will be tested by the purchaser to determine whether they do or do not comply with the standard specifications for water meters adopted by the American and New England Water Works Associations.

* *Note:* Sentence (a) is to be used where the purchaser does not have suitable equipment to test the meters. If he has such equipment then sentence (b) is to be used.

6. Registers shall be $\left\{ \begin{array}{l} \text{round} \\ \text{straight} \end{array} \right\}$ reading
and shall record in $\left\{ \begin{array}{l} \text{cubic feet} \\ \text{gallons} \end{array} \right\}$

Equipment necessary to test meters for compliance with registration and capacity requirements as set forth in the standard specifications for water meters

The standard specifications require that meters shall accurately record the flow within certain limits and shall pass a given quantity of water with a maximum loss of pressure. Suitable equipment to make accurate tests must be available before the purchaser should make complaint of meters not complying with the specifications.

The minimum test equipment required for registration and capacity is as follows:

1. A quick-acting valve on the supply pipe through the use of which the flow can be started and stopped without appreciable loss of time.

2. A valve on the outlet side of the meter which can be used to establish the rate of flow desired.

3. Pressure gauges connected on both the inlet and outlet of the meter to show whether any material change in pressure occurs during the period of test which would affect the rate of flow. (The outlet pipe is to have sufficient head on it so that the meter will always have pressure on its outlet end and preferably not less than 5 pounds per square inch.)

4. A measuring device which may be either of the volumetric or weighing type. Whichever is used, the accuracy of determination of the volume or weight of water discharged into the measuring device must be such as to bring the limit of error within one-tenth of 1 per cent. (The volume of water passed must be sufficient to cause at least one or more revolutions of the pointer on the initial dial except for tests at "minimum test flow" rate. For the latter test, the amount passed shall not be less than one cubic foot.)

It is desirable to have available for testing meters a test table and appurtenances which are manufactured by several concerns. Such an outfit would include the equipment enumerated in the preceding four paragraphs.

For the capacity tests, it is necessary to add to the above equipment, two piezometer rings which must be of exactly the same diameter. The piezometer rings must be free from any burrs where the holes are drilled through the wall of the ring and not less than four holes shall be provided, drilled in

pairs and on diameters at right angles to one another. The inlet piezometer ring shall be set close to the meter, and shall be at a distance of not less than eight diameters from the nearest upstream stop cock or fitting in the supply pipe. The outlet piezometer ring shall be placed at a distance of not less than eight nor more than ten diameters from the outlet of the meter. The diameter of the piezometer rings and inlet and outlet pipes shall be the same as the size of the meter to be tested. The piezometer rings are to be connected by either rubber or metal tubing to a mercury U-tube. To this U-tube is to be attached an accurate adjustable scale for measuring the differences between the inlet and outlet pressures. Provision is to be made for the complete removal of air from the tubing connected with the U-tube, and the U-tube and the tubing connected therewith are to be so placed that the air will rise to the outlets. Where relatively high flows are to be recorded, it is necessary to read both sides of the mercury column to compensate, as far as practicable, for irregularities in the diameter of the glass U-tube, and such readings are to be made as nearly simultaneously as possible to avoid errors due to fluctuations.

Tests of meters recommended

The tests to be made on the meter are divided into two classes: 1, Capacity test; 2, registration test.

Capacity tests are those which test the design of the meter rather than the workmanship thereof. When a meter of a given make has once been tested for capacity, it should not be necessary to again test this type of meter unless a change has been made in its design.

The registration tests should be made on each meter, as the results are affected by workmanship and assembly of individual meters. There is no certainty that, because one meter of a given make comes within certain limits of accuracy, another meter of the same make turned out by the factory on the same day will necessarily give similar results. The register furnished with each meter should be used by both the manufacturer and purchaser in making registration tests. Where the purchaser does not have the necessary equipment to test the meters, there should be furnished by the manufacturer a certificate that each meter has been tested for accuracy of registration and complies with the standard specifications in this respect, and that the type of meter furnished has complied with the capacity requirements.

The registration tests recommended are as follows:

All meters should be tested for accuracy of registration within and as near as practicable to the low and high rates given under "Normal Test Flow Limits."

A test at the "Minimum Test Flow" should be made on as many as possible and not less than 5 per cent of the meters. If the results obtained from testing 5 per cent of the meters show that any meter does not comply with the low flow requirement, additional meters should be tested to the extent deemed necessary to make certain that the other meters do comply therewith.

The pressure test should be made on each size of meter furnished of a particular type. This pressure is to be 150 pounds per square inch and the pressure may be furnished through the use of a hand pump or such other

method as may be available. Before the meter has been tested by static pressure and also after it has been so tested, it should be tested for accuracy to see whether the meter has been so distorted as to affect registration. It is considered unnecessary to make a pressure test of each size of meter of a given type more than once if satisfactory results are obtained.

If it be possible to give a working pressure test under 150 pounds per square inch then such a test should be applied rather than a static pressure test.